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ABSTRACT

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WORDS AND PICTURES: REPLICATION AND REINTERPRETATION

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SUMMARY

A replication and extension of Samuels' (1967) original experiment assessing the learning performances of no-picture, simple-picture and complex-picture groups almost exactly duplicated the original findings in acquisition performance. However, the critical test-trials results did not confirm Samuels' original contention that pictures can act as distractors in learning correct reading responses. Application of a conditioning model revealed that the no-picture group received the overwhelming amount of adult verbal feedback during acquisition and provided the theoretical basis of the notion that "no-picture" learning occurs through a visual-auditory conditioning process; "simple-picture" learning occurs through a visual-visual conditioning process and "complex-picture" learning occurs through a combination of both.

A. INTRODUCTION

The original acquisition and subsequent retention of reading responses in young schoolchildren represents an area of investigation in educational psychology having both theoretical and pedagogical importance. The results of studies which examine the acquisition and retention of reading responses may be used to provide evidence for theoretical accounts of the processes and mechanisms involved in successful and non-successful reading performance and, simultaneously, may also be used as the basis upon which to develop methods of reading instruction.

In 1967, Samuels (10) reported the results of a series of studies that dealt with the effect of pictures upon the original learning of reading responses to printed words. His results, as well as those of Braun (2) and Harris (4) supported the contention that pictures can act as distractors and thereby function to retard the learning of reading responses to accompanying words.

The Samuels' design calls for three groups: a group learning to read without pictures, a group learning to read the same words with simple pictures accompanying the words and a group learning to read the same words with complex pictures accompanying the words.

A conditioning model applied to this experimental design reveals that for the no-picture group the critical association is one formed between the sight of the word (CS) and the sound of the word (UCS). The critical association formed in the two picture groups is between a compound stimulus consisting of a picture-plus-the-printed-word and the sight of the word.

Thus, the essential experimental test of whether pictures aid or distract learning is based, in the Samuels' design, upon the difference between the use of a single versus a compound stimulus.

Since the highly complex set of cognitive processes (and their affective concomitants) involved in the total behavioral accomplishment of "learning-to-read" may well represent one of the most crucial factors in overall school success or failure; and since the work of Samuels and his co-workers apparently provided such clear evidence that pictures can function as distractors; it was decided that an exact replication of Samuels' original "Experiment I" should be performed (10). However, in order to gain a further understanding of the theoretical processes involved during the acquisition of reading responses, Experiment I was extended to include a measure of retention. Harris (4) reported that using low SES subjects, measures of retention taken after a 24 hour interval were found to be independent of mode of presentation (picture vs. no-picture treatments). The retention measures employed in the present study were added to the original Samuels (10) design to assess retention in middle class subjects utilizing short-term intervals (approximately 20 minutes).

B. METHOD

1. Subjects. Thirty children who were in their last month of a year of kindergarten experience in a predominantly white, middle class school system in New Jersey were randomly assigned to one of three experimental treatments. Their ages ranged from 5.8 years of 6.7 years. S's were pretested and chosen only if they could not read the words to be used in the experiment.

2. Design. A simple, randomized design was used. Ten S's were randomly assigned to the no-picture, 10 to the simple-picture and 10 to the complex-picture condition.

3. Materials. The pretest materials consisted of four 5 x 8 inch unlined index cards with the word "boy," "bed," "man" or "car" typed on them.

The warm-up materials consisted of twelve 5 x 8 inch unlined index cards with nonsense figures (approximating the Roman numerals 1, 2, 3 and 4) drawn on them. Only one figure was drawn on each card.

The acquisition materials consisted of 120 5 x 8 inch unlined index cards with the words boy, bed, man and car typed on a primary typewriter at the bottom of each card. Only one word was typed on each card. Using the same four words, every subject in each of the three groups was given forty acquisition trials.

For acquisition in the no-picture group, there was a word at the bottom of each of the forty cards but no picture was present.

For acquisition trials in the simple-picture group, there was a simple black and white picture from a reading primer, representing the word at the bottom of each of the forty cards.

For acquisition trails in the complex-picture group, there was a colored picture representing the word at the bottom of each of the forty cards. Clipped from a basal reading primer, the pictures were complex because they represented the word within the scene which included several other objects (i.e., the "boy" picture included a boy, a tree, a tree house, etc). In the simple-picture group, the word was depicted by only the isolated object itself.

The test materials consisted of 120 5 x 8 inch unlined index cards with the words boy, bed, man or car typed at the bottom of the card. No pictures were used in the test trials; each subject in each group received forty test trials.

The retention materials were the same as the test materials.

4. Procedure

Pretest - The experimenter worked individually with the S's during all phases of the procedure. A pretest was given to each S. The S was told, "Today, we are going to play a game. In this game you are going to learn some words. First, let us see if you already know what the names of the words are." The four words were shown to the S. If he was able to read any of the words, he was eliminated.

5. Warm-up trials. Following the pretest a warm up was given to each S to acquaint him with the nature of the learning task. The S was told, "Before we learn the new words, let us practice on some numbers. I will show you a card with a funny-looking number on it and I want you to tell me what the number is. If you don't know the number's name I will tell you what it is. You should try to tell me what the number is before I tell you. Do you understand what we are to do? All right? Then what do you do when I show you a card with a number on it?"

Each card was shown to the child for four seconds. If he did not correctly identify the numeral within the allotted time, the investigator told him the numeral. Each child was given three randomly-ordered warm-up trials per numeral, for a total of 12 warm-up trials.

6. Acquisition trials. After the warm-up, the acquisition trials began. Working individually with each child, the investigator, introduced the training procedure by saying, "All right, let us see how we can learn new words. I will show you a card with a word on it and I want you to tell me what the word's name is. If you don't know the word's name the first time you see it, I'll tell you. You should try to tell me the name before I tell you. The second time you see the word, try to read the word's

name to me. If you don't know the word's name I will not tell you. Do you understand?" (Note: These instructions are slightly different than Samuels' (10) original instructions. Pilot testing indicated the need to make them more explicit).

Each card was presented for four seconds. If the child did not correctly identify the word within the allotted time, the investigator said the correct response as feedback for the child. For acquisition trials. a correct response was recorded if the child said the word before the investigator provided the feedback.

7. Test Trials. Throughout the experiment, each acquisition trial was alternated with a test trial on the same word; words being randomly presented. During the test trials, the test cards were presented for four seconds. If the child did not identify the word within the allotted time, no feedback was given by the investigator. Words only were represented on the test cards for all three groups. Each child received ten acquisition and ten test trials per word; therefore, a total of forty acquisition trials and forty test trials were recorded for each S.

8. Retention Trials. The procedures used to measure retention represent an extension of the original Samuels' (10) design. Brackbill and Lintz (1) and Sassenrath and Yonge (13) have indicated a delayed time effect wherein retention increases after delay intervals. More (7) has written that "...retention of what is learned is a primary objective of instruction and testing" (P. 341). Therefore, after each S received forty acquisition trials and forty test trials, forty retention trials were administered in the same randomly presented order.

Pilot testing had indicated that about ten minutes were required for the acquisition and test phases. Three children were selected from

their classroom at one time and tested individually while the other two played with toys in an adjoining room. When all three had been tested, the first child re-entered the test room and was given 40 retention trials which lasted about five minutes; by waiting five minutes before bringing in the second child and repeating this procedure after testing the second child, all children were tested for retention after a delay which very closely approximated twenty minutes for all thirty subjects in the experiment.

C. Results

The first analysis performed on the data concerned the question of the degree of accuracy of replication between the present study and Samuels' original results for the acquisition trials.

Table 1 contains the comparison between the two studies.

(Insert Table 1 here)

The "accuracy of replication" in the table is simply the percentage obtained when the means obtained by Samuels are divided by the means obtained in the present study. Thus, the accuracies of replication for all three groups (98.8% for no-picture group; 98.7% for simple-picture group and 96.9% for complex-picture group) indicate that the present attempt to faithfully replicate the work of Samuels, as far as the acquisition trials are concerned, were successful.

Table 2 contains the means and standard deviations obtained for all three groups during acquisition, test and retention trials throughout the present experiment.

(Insert Table 2 here)

On the acquisition trials, as seen in Table 2, the mean number of correct responses given for the no-picture group was 25.60; for the simple-picture group 39.90; and for the complex-picture group it was 38.10. Comparing the simple-picture group to the no-picture condition during acquisition, Ss in the simple picture group gave significantly more correct responses ($t=5.80$; $df=18$, $p<.001$). Comparing the complex-picture group to the no-picture group, Ss in the complex picture group gave significantly more correct responses ($t=5.05$; $df=18$, $p<.001$). These results for acquisition trials are essentially the same as those reported by Samuels (10). However, an additional analysis of the acquisition data revealed that in the present study, S's in the simple-picture group gave significantly more correct responses than S's in the complex-picture group ($t=7.10$; $df=18$, $p<.001$).

Therefore, it can be seen that although the simple-picture group was superior to the other two groups in acquisition performance; the two picture conditions yielded significantly greater acquisition of the reading responses than did the no-picture group.

The use of pictures, therefore, appears, once again, to aid the acquisition of reading responses to printed words; and, the simpler the picture, the better the level of acquisition.

On the test trials, the results of the present study appear to be greatly at variance from those reported by Samuels(10). Table 3 shows the comparison of the two studies on the critical test trials.

(Insert Table 3 here)

As may be seen in Table 3, the mean number of correct test trial responses given by the subjects in the present study strikingly increased for all three conditions when compared to those of the Samuels study (no-picture group mean of 38.60 for present study increased 201% from the mean of 19.20 reported by Samuels' simple-picture group mean of 36.90 for present study increased 327% from the mean of 11.30 reported by Samuels; and the complex-picture group mean of 35.90 for present study increased 309% from the mean of 11.60 reported by Samuels).

Thus, the results of the present study indicate that test trial performance may be twice or three-times more accurate than the levels previously reported by Samuels (10).

Furthermore, whereas the main findings of the original Samuels study were significant differences in test trial performance in favor of the no-picture group when compared to the two picture groups; t-test analyses of the test trial results of the present study revealed no significant differences amongst the three groups on test trial performance.

It should be noted, however, that consistent with Samuels original results, a slight superiority in test trial performance was demonstrated by the no-picture group in the present study (no-picture test trial mean was 38.60; simple-picture test trial mean was 36.90; complex-picture test trial mean was 35.90).

A further analysis of the means for all three groups resulting from acquisition, test and retention trial scores which appear in Table 2 reveals that in all instances, save one, the means within each group decrease from acquisition, to test trials, to retention trials. The only exception is the sharp increase of 13.00 trials in the mean performances within the no-picture group from acquisition to test trials ($\bar{X}$ acquisition

performance of 26.90 correct trials which rises to a mean test trial performance of 38.60 correct test trials).

At first glance, this sharp increase in correct performance within the no-picture group appears to be some form of latent learning acquired during acquisition trials and manifested during test trials.

However, if one recalls that the experimental design (originally employed by Samuels and replicated herein) includes the provision for investigator verbal feedback during acquisition should the child fail to produce the required reading response, then it becomes obvious that every error or failure to respond within all three treatment conditions during acquisition is also the occasion for verbal feedback of the correct response.

Table 4 presents the results of tabulating the number of verbal feedbacks given by E during acquisition.

(Insert Table 4 here)

The no-picture group, as revealed in Table 4, required 88% of total amount of feedback provided by E (142 out of a total of 162 verbal feedbacks); the simple-picture group required only about 1% (1 out of 162 total feedbacks); and the complex-picture group was given 11% of the total verbal feedback (19 out of 162 total feedbacks).

Thus, the provision for verbal feedback within the experimental design resulted in a situation wherein the overwhelming amount of adult verbal feedback was provided to the no-picture group. Since acquisition and test trials were alternated; it must be noted that the no-picture group received 142 verbal feedbacks just prior to each of 142 test trials.

On retention trials, as may be seen in Table 2, the greatest amount of retention occurred with the no-picture group (a mean of 32.50 correct responses); followed closely by the complex-picture group (a mean of 31.30 correct responses) and with the least amount of retention present in the simple-picture group (a mean of 26.70 correct responses). However, t-test analyses revealed no significant differences in retention performance amongst the three treatment conditions.

As Samuels (10) so [illegible]oted, a young child will often attend to the first letter of a word and thereby confuse a word like "house" for a word like "horse." It was surprising therefore, to find that in Samuels' original study of the four words used, "boy" and "bed" started with the same consonant. It was recognized that this apparent source of confusion could be utilized to determine the relative frequency of first-consonant confusion amongst the three treatment conditions. Therefore, the hypothesis was put to test that pictures would serve as an aid in avoiding first-consonant confusion. Table 5 contains the results of testing the experimental question that "boy" - "bed" confusions would more often occur in the no-picture group during acquisition.

(Insert Table 5 here)

As Table 5 indicates, during acquisition, children in the no-picture group confused the words boy and bed 24 times while the confusion never occurred with the use of either simple or complex pictures. A chi-square analysis revealed that the boy-bed confusions occurred with significantly greater frequency within the no-picture than in either of the picture groups ($\chi^2=48.98$, df=2, $p<.001$).

No significant differences occurred during test trials or retention trials in the amount of boy-bed confusions.

Therefore, it seems that pictures can serve to help distinguish between words that begin in the same consonant during the acquisition of reading responses to those words.

Finally, an analysis of boy-girl differences revealed no significant differences based upon sex as a variable.

D. Discussion and Summary

The striking similarity of results in acquisition trial performance between the present study and the original Samuels' experiment indicates:

1) that the present study is apparently a faithful replication of the original,

2) that pictures may function as facilitators during acquisition trials and,

3) that, in this experimental paradigm, the acquisition of the correct response to a printed word occurs to a significantly greater extend with the use of compound stimuli (simple-picture-plus-word and complex-picture-plus-word) than when a single stimulus alone is employed (word only in no-picture group).

Furthermore, the results of the present study indicate that the use of a simpler compound stimulus (single pictorial representation of word-object as used in the simple-picture group) leads to significantly more correct responses than the use of a complex compound stimulus (pictorial representation of the word-object embedded within a scene as used in the complex-picture group).

Just as strickingly, the results of the present study fail to support Samuels' (10) original findings that the no-picture group performs significantly better on the critical test trials than do the two picture groups. No signi-

ficant differences in the test trial performance of the three groups was found in the present study. Since the original Samuels experiment based its contention that pictures can act as distractors upon the results of the test trials, further analysis was performed on the data of present study. Analysis of the amount of experimenter verbal feedback revealed that the test trial performance of the no-picture group occurred immediately following 88% of the total feedback provided by E during the entire experiment. This finding of significantly more verbal feedback given to the no-picture group raises three issues:

1) Theoretically, if experimenter verbal feedback can be viewed as reinforcement of the child's response of attending to the stimuli present on the cards, then can the hypothesis of distraction by pictorial representation of the printed words be adequately tested when one group (the no-picture group) requires the overwhelming amount of such reinforcement?

2) Since the no-picture group received 142 verbal feedbacks just prior to 142 test trials, how many of these test trials represent true conditioned reading responses as opposed to simply delayed echoic, imitative responses to the feedback? and,

3) Pedagogically, the use of no-picture methods of reading instruction would appear to be much more demanding of costly one-to-one teacher ratios and less amenable to the production of efficient reading within the more common group instruction ratios than the picture-methods because of the apparently greater need for teacher-reinforcements.

Studies are currently being planned at our university to control the amount of verbal feedback and assess the effects of this methodogical change upon the results of the original Samuels design.

Although Samuels and his co-workers (Harris, (4) and Braun, (2) viewed the experimental design in terms of the simplest possible conditioning paradigm, the results of the present replication have led the present authors to an

appreciation of the true complexity of the situation.

At least the following stimuli and responses may be distinguished:

1) CS_1 = card with printed word only (no-picture group)

2) CS_2 = card with simple picture plus CS_1 (simple-picture group)

3) CS_3 = card with complex picture plus CS_1 (complex-picture group)

4) OR_1 = orienting response of attention to CS_1

5) OR_2 = orienting response of attention to CS_2

6) OR_3 = orienting response of attention to CS_3

7) UCS_1 = verbal feedback by E to word appearing in CS_1

8) UCS_2 = verbal feedback by E to word appearing in CS_2

9) UCS_3 = verbal feedback by E to word appearing in CS_3

10) UCR_1 = echoic response to UCS_1

11) UCR_2 = echoic response to UCS_2

12) UCR_3 = echoic response to UCS_3

13) CR_1 = conditioned reading response to CS_1

Using the above list it became possible to construct a classical conditioning paradigm for each group as follows:

No-Picture	Simple-Picture	Complex-Picture
$CS_1 \rightarrow OR_1$	$CS_2 \rightarrow OR_2$	$CS_3 \rightarrow OR_3$
$^{+}UCS_1 \rightarrow UCR_1$	$^{+}UCS_2 \rightarrow UCR_2$	$^{+}UCS_3 \rightarrow UCR_3$
$CS_1 \rightarrow CR_1$	$CS_1 \rightarrow CR_1$	$CS_1 \rightarrow CR_1$

If CS_1, CS_2 and CS_3 were equivalent stimuli, then the paradigm for all three groups would simply reduce to the paradigm for the no-picture group. However, this is not the case. It has already been herein noted that CS_1 is a simple stimulus and CS_2, as well as CS_3, are compound stimuli. OR_1, OR_2 and OR_3 are orienting responses to these quite different conditional stimuli.

It is interesting to note that the demands of the present learning situation may actually lead to an accentuation, rather than the customary attentuation, of the orienting response. It may be that the final conditioned response is not simply CS_1 followed by CR_1, but actually a chained reaction of:

$$CS_1 \rightarrow OR_1 \rightarrow CR_1$$

In other words, unless the child actually visually attends (OR_1) to the printed word (CS_1), no correct response (CR_1) can occur. Previous workers appear to have assumed that verbal feedback (UCS_1, UCS_2 and UCS_3) was equally presented to all groups; however, it has also been previously herein noted that UCS_1 was required 142 times by the no-picture group, only once by the simple-picture group and 19 times by the complex-picture group. The model, as presented above, appears to be accurate for the learning that occurred in the no-picture group. But, the model fails to explain how nine out of ten subjects in the simple picture group could have learned the correct reading response in the total absence of the auditory UCS_2 (since only one UCS_2 was given, obviously, only one subject received this form of stimulation).

Therefore, the superior acquisition performance of the simple-picture group present in both the original Samuels report and in this replication can not be explained with the paradigm above. The answer appears to lie in the fact that CS_2 represents a compound visual stimulus containing a conditional visual stimulus (novel stimulus of printed word, hereinafter referred to as CS2A) as well as, an unconditional visual stimulus (by Pavlovian definition an unconditional stimulus (9) is one that reliably evoked an unconditional response at the start of the experiment; the simple line drawings of the boy, bed, man and car appear to have functioned in this manner, they are hereinafter referred to as UCS2B). Thus, the learning that occurred in the simple-picture

group can be diagrammed thusly:

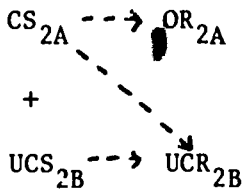
$CS_2 = CS_{2A} + UCS_{2B}$

CS_{2A} = printed word = CS_1

UCS_{2B} = pictorial representation of CS_{2A}

UCR_{2B} = verbal response by S to UCS_{2B}

(note: $UCR_{2B} = CR_1$)



$CS_1 \dashrightarrow CR_1$

The paradigm above may be interpreted as stating that the learning which occurred in the simple-picture group was a process whereby the novel visual stimulus (printed word) came to be able to elicit the response originally reliably evoked by the unconditioned visual stimulus (simple picture).

Since verbal feedback by E for the simple-picture group occurred only once in 400 acquisition trials, auditory verbal feedback played no role in the learning of nine out of ten subjects and was present for the learning of only one word in the other subject.

This proposed visual-visual model to account for the learning of the simple-picture group can be directly applied to the results of the complex-picture group. It can be postulated that since UCS_3 occurred 19 times in the complex-picture group (probably due to the fact that the critical stimulus was embedded and its distinguishability required more verbal feedback) the learning which occurred in this group was probably some combination of visual-visual conditioning (with CS_3 as both CS_{3A} and UCS_{3B}) and visual-auditory conditioning (with CS_3 as visual stimulus and UCS_3 as auditory stimulus).

The above discussion leads to the following conclusions:

1) Learning in the no-picture condition most probably occurs through a visual-auditory conditioning process wherein the crucial associacion is the one formed between the printed word and the sound of the word provided by E,

2) Learning in the simple-picture group has been herein demonstrated to occur in the total absence of the sound of the printed word and most probably occurs through a visual-visual conditioning process wherein the crucial association in the one between the printed word and the picture representing the printed word.

3) Learning in the complex-picture group is most probably the resultant of two conditioning processes: visual-auditory and visual-visual conditioning. and, 4) Pedagogically, unless machines are used, a no-picture method of instruction requires individual feedback by a teacher (to provide UCS_1) while a simple-picture method of instruction could proceed without a teacher's presence once the teacher ascertains that the children can give the required correct response to the simple pictures being used (a check on the accuracy of the UCS_{2B} -- UCR_{2B} association).

The lack of significance found in the present study in the extension to include a measure of retention tends to confirm the findings of Harris (4) and Braun (2, 3) that mode of presentation does not significantly affect the retention of reading responses.

Furthermore, since no significant differences were observed in the present study between the three treatment groups during the test trials, it would appear that finding no significant differences in retention is consistent with the idea that three groups which have performed in an essentially equivalent manner during the first test of reading (test trials) would perform in essentially the same manner during a second test on exactly the same material (retention trials) approximately twenty minutes later.

No evidence for any delayed-retention effect (Such as that reported by Brackbill and Lintz, 1) was found.

Finally, the results of the analysis of the "boy-bed" confusion wherein there was a significantly greater amount of first-consonant intrusions within the no-picture group than within either fo the two picture conditions can be combined with the preceeding theoretical conditioning analyses. The conclusion to be drawn is that visual-visual conditioning processes seem to eliminate first consonant confusions whereas visual-auditory conditioning processes do not. May it not be, that in young children, dyslexic dysfunctions of this type are more likely to arise within the auditory modality than within the visual modality?

The results of the present replication indicate that pictures, especially simple pictures, can act as facilitators during acquisition trials. Pictures may also serve to avoid first consonant errors.

The results of the present study contain no significant findings that would support the contention that pictures may act as distractors. The slight superiority of test trial performance by the no-picture group may be due to the overwhelming amount of adult verbal feedback received by this group and not to any inherently efficient learning process utilized by children in the absence of pictures.

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TABLE 1

COMPARISON BETWEEN MEAN ACQUISITION SCORES OBTAINED IN SAMUELS' (1967) STUDY AND MEAN ACQUISITION SCORES OBTAINED IN PRESENT REPLICATION STUDY

Treatment	Mean acquisition scores		Accuracy of replication
	Samuels (1967)	Present study	
No-picture	25.3	25.6	98.8%
Simple-picture	39.4	39.9	98.7%
Complex-picture	36.9	38.1	96.9%

TABLE 2

ACQUISITION, TEST, AND RETENTION MEAN SCORES OBTAINED BY NO-PICTURE, SIMPLE-PICTURE, AND COMPLEX-PICTURE GROUPS

	No-picture			Simple-picture			Complex-picture		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Acquisition	10	25.6	7.79	10	39.9	0.32	10	38.1	0.74
Test	10	38.6	1.71	10	36.9	4.23	10	35.9	4.86
Retention	10	32.5	7.44	10	26.7	8.42	10	31.3	9.08